

Patent claims

1. Phase contrast X-ray device (1) for creating a phase contrast image (17) of at least one object (4), with
 - at least one X-ray source (2) for generating an X-radiation (11), that has a specific spatial coherence (15) within a specific optical distance (6) to the X-ray source (2), and
 - at least one evaluation unit (16) for converting the X-radiation (12, 13) after the X-radiation (11) has passed through the object (4) arranged within the optical distance (6) to the X-ray source (2) in the phase contrast image (17) of the object (4), characterized in that
 - the X-ray source (2) shows an output ranging from 50 W up to and including 10 kW and
 - a spatial coherence length (14) of the X-radiation (11) has been selected within the optical distance (6) to the X-ray source (2) ranging from 0,05 μm up to and including 10 μm .
2. X-ray device according to claim 1 in which the X-ray source (2) has a line-shaped focus (7).
3. X-ray device according to claim 1 or 2 in which a longitudinal extension of the line-shaped focus (7) is aligned in the direction towards the object (4).
4. X-ray device according to one of the claims 1 to 3 in which the X-ray source (2) has an X-ray tube with a transmission anode.
5. X-ray device according to one of the claims 1 to 3 in which the X-ray source (2) has a parametric X-radiation source (PXR).
6. X-ray device according to one of the claims 1 to 5 in which the X-radiation (11) has a specific temporal coherence (15).
7. X-ray device according to one of the claims 1 to 6 in which there is at least one monochromator (18) for generating the temporal coherence (15) of the X-radiation (11).
8. X-ray device according to one of the claims 1 to 7 in which the evaluation unit (16) has at least one analyzer (19) for

analyzing the X-radiation (12, 13) after it has passed through the object (4).

9. X-ray device according to claim 7 or 8 in which the monochromator (18) and/or analyzer (19) has at least one gradient multilayer reflector (20).
10. X-ray device according to claim 9 in which the gradient multilayer reflector (20) has a periodic series of layers of a first layer type A (22) and at least a further layer type B (24) in which case the first layer type A (22) has a first refractive index r_A and a first layer thickness d_A (23) and a further layer type B (24), a further refractive index r_B and a layer thickness d_B (25) differing from the first refractive index r_A and in at least one direction of propagation of the reflector (20), there is a monotone increase in layer thicknesses by a total of $(d = d_A + d_B)$ (26).
11. X-ray device according to claim 9 or 10 in which the gradient multilayer reflector (20) has at least one area of reflection (27) from the elliptical and/or parabolic and/or planar and/or circular and/or hyperbolic group.
12. Method for creating a phase contrast image of an object by using a phase contrast X-ray device according to one of the claims 1 to 11, with the following procedural steps:
 - a) Arranging the object within the optical distance to the X-ray source,
 - b) X-radiation passing through the object and
 - c) Creating the phase contrast image from where the X-radiation passes through an object by means of the evaluation unit.
13. Method according to claim 12 in which the X-radiation forms an interference pattern after it has passed through the object that is detected for creating the phase contrast image.
14. Method according to claim 12 in which an X-radiation which is deflected when passing through the object for creating the phase

contrast image and/or an X-radiation which is non-deflected when passing through the object is detected.

15. Method according to claim 14 in which the deflected X-radiation and/or non-deflected X-radiation is selected by means of an analyzer with a gradient multilayer reflector.
16. Method according to one of the claims 12 to 15 in which several phase contrast images are created by means of the X-radiation of different spatial coherences that are processed to an overall phase contrast image by means of an image processing unit.
17. Method according to claim 16 in which the optical distance between the object and the X-ray source varies for generating the different spatial coherence.
18. Method according to claim 16 or 17 in which orientation of the object to the direction of propagation of the X-radiation varies for generating the different spatial coherence.
19. Method according to one of the claims 12 to 18 in which an object that, in essence, consists of a material with a low absorption coefficient for the X-radiation is used.
20. Method according to one of the claims 12 to 19 in which many phase contrast images of the object are created to generate a phase contrast computer tomogram of the object.